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(71) Applicant(s):
ANT Software Limited
(Incorporated in the United Kingdom)
First Floor, 335 Cambridge Science Park,
Milton Road, CAMBRIDGE, Cambridgeshire,
CB4 OWN, United Kingdom

(72) Inventor(s):
David Fell
Simon Middleton

(74) Agent and/or Address for Service:
Page White & Farrer
Bedford House, John Street, London, WC1N 2BF,
United Kingdom

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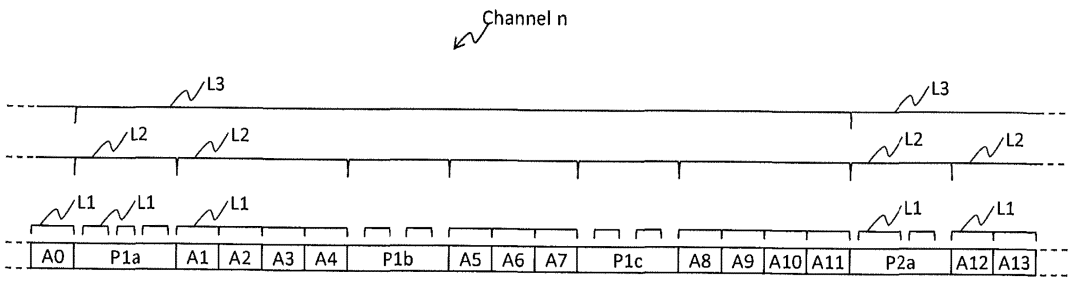
(58) Field of Search:
INT CL **H04N**
Other: **EPODOC; WPI; TXTE**

(54) Title of the Invention: **Television system**
Abstract Title: **Processing supplementary interactive content in a television system**

(57) Items of interactive content such as advertisements or commercials A1, A2 etc in main video content such as program parts P1a, P1B etc on a television system are handled by: determining a hierarchical time structure having a plurality of nested levels ordered from a lowest L1 to a highest L3 level, the lowest level having a respective time window for each item of interactive content and the level above it having a time window corresponding to a plurality of time windows at the lowest level; and receiving user operations at a user terminal, where a first user operation accesses on screen an item of interactive content associated with a current lowest level time window and a second user operation generates a list of interactive content items falling within a higher level time window embracing the accessed interactive content item. The second user operation may cause the list to be generated on a device e.g. tablet or laptop external to the user terminal on which the main video content is viewed. The first and second user operations may be single and double button presses on a remote control unit.

Figure 6



GB 2491894 A

Figure 1a

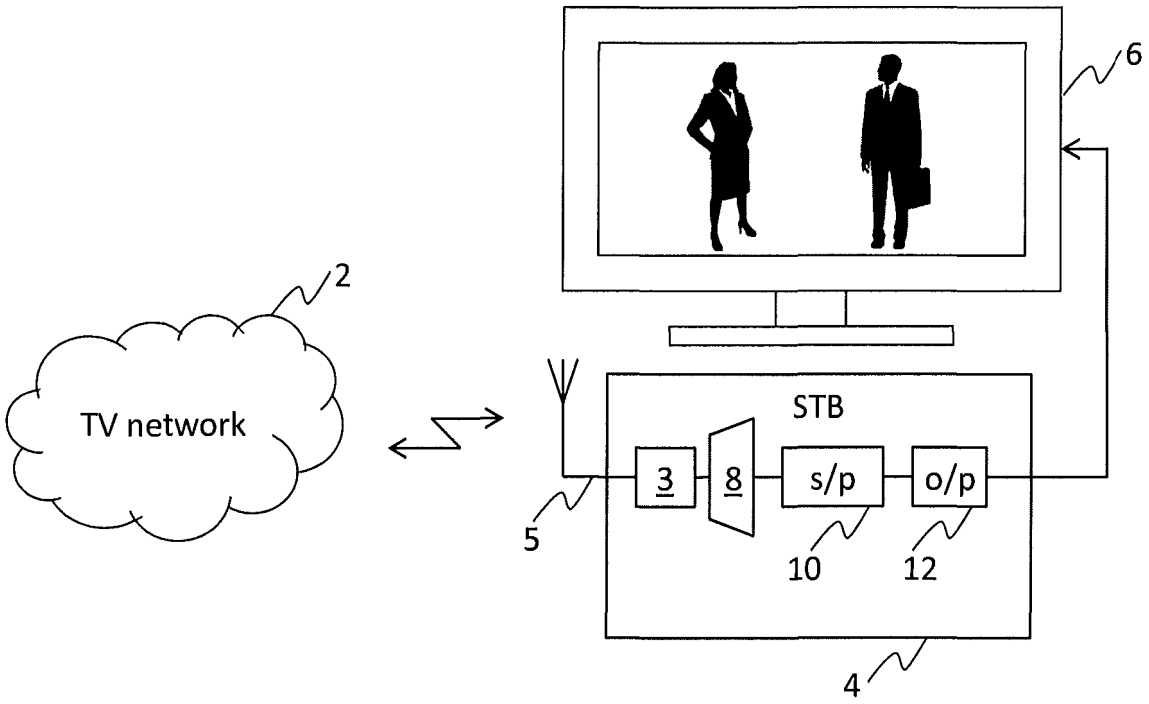


Figure 1b

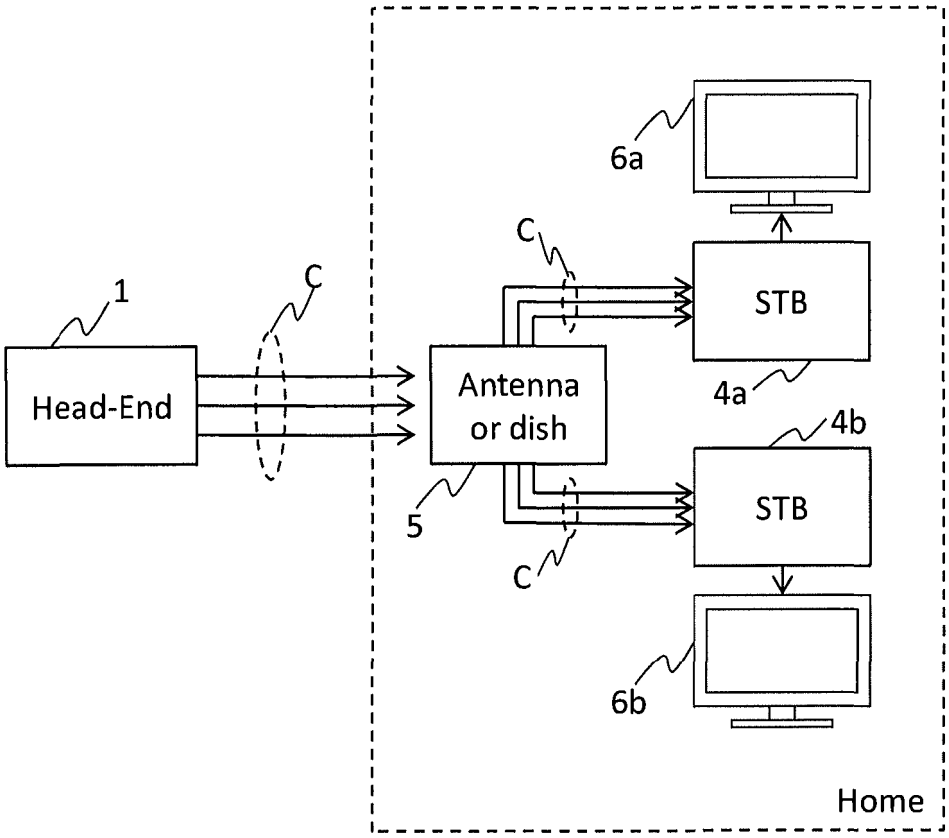


Figure 1c

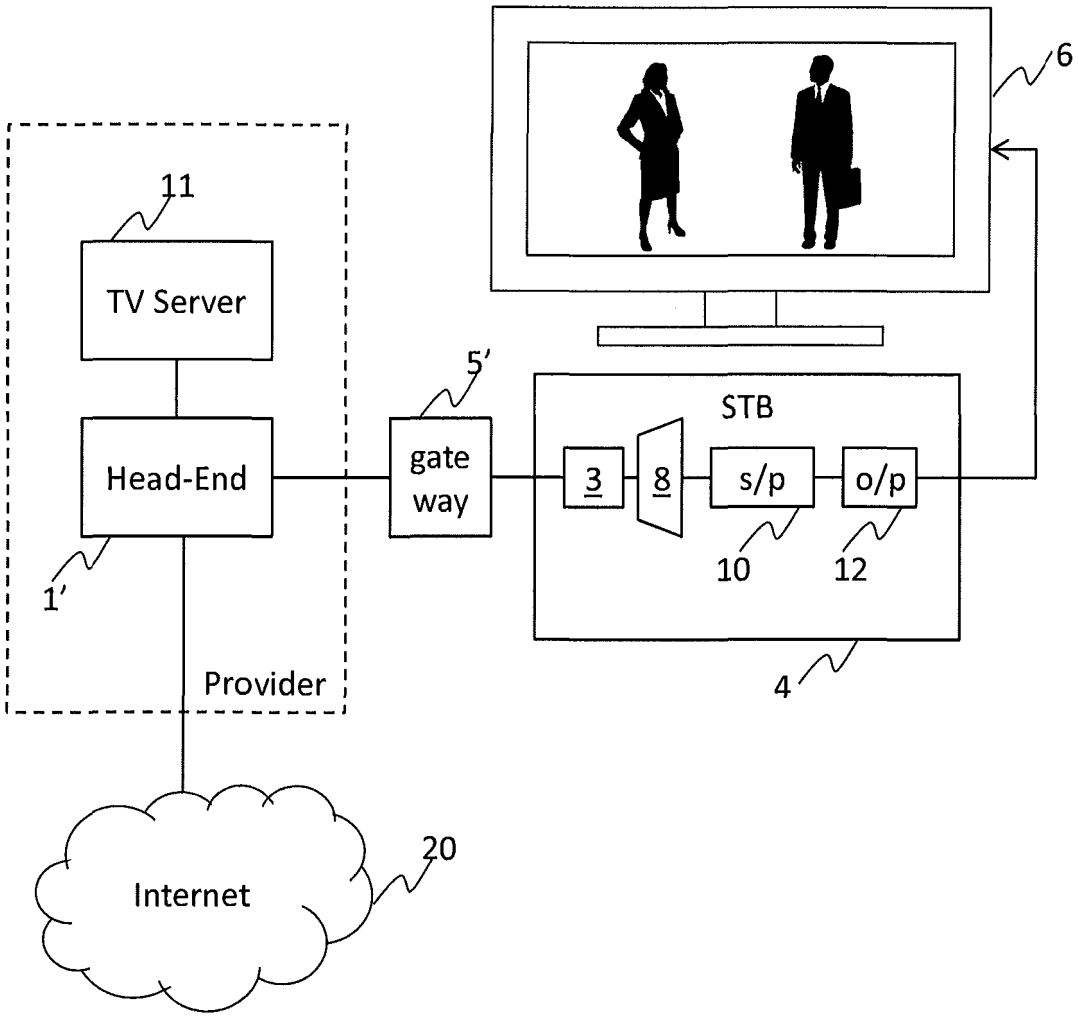

6
11
TV Server
5'
STB
Head-End
gate
way
3
8
s/p
o/p
10
12
1'
4
Provider
20
Internet

Figure 1d

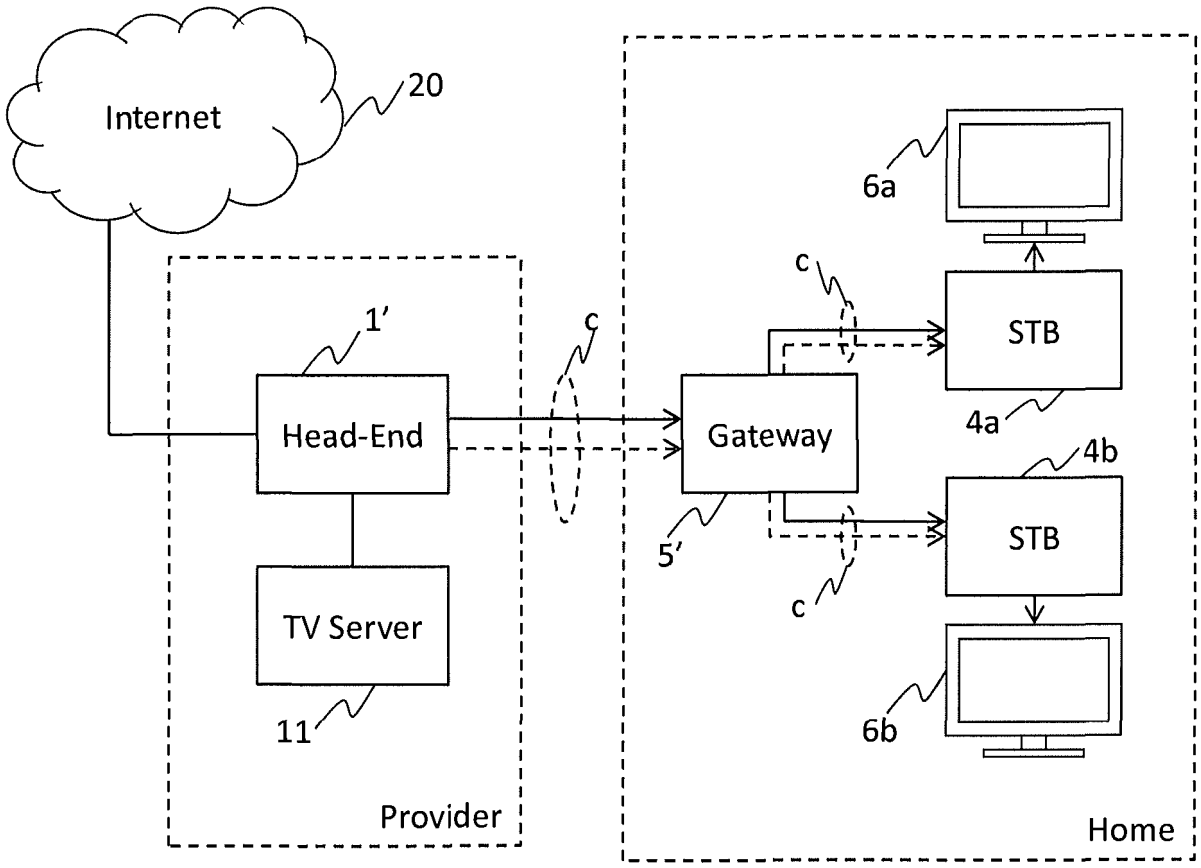

Internet
20
1'
Head-End
TV Server
11
Provider
c
Gateway
5'
c
c
6a
STB
4a
4b
STB
6b
Home

Figure 2a

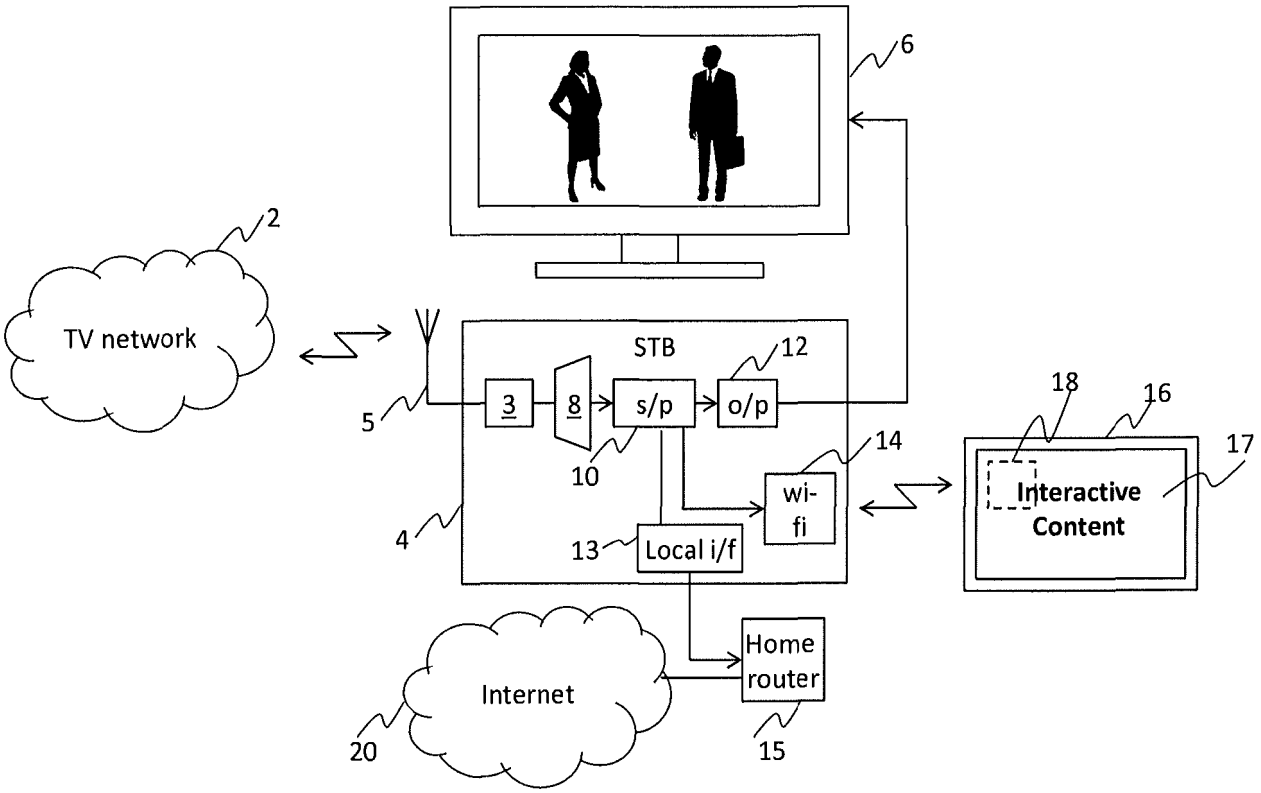

6
2
TV network
STB
12
3
8
s/p
o/p
18
16
17
5
10
14
wi-
fi
Interactive
Content
4
13
Local i/f
Home
router
Internet
20
15

Figure 2b

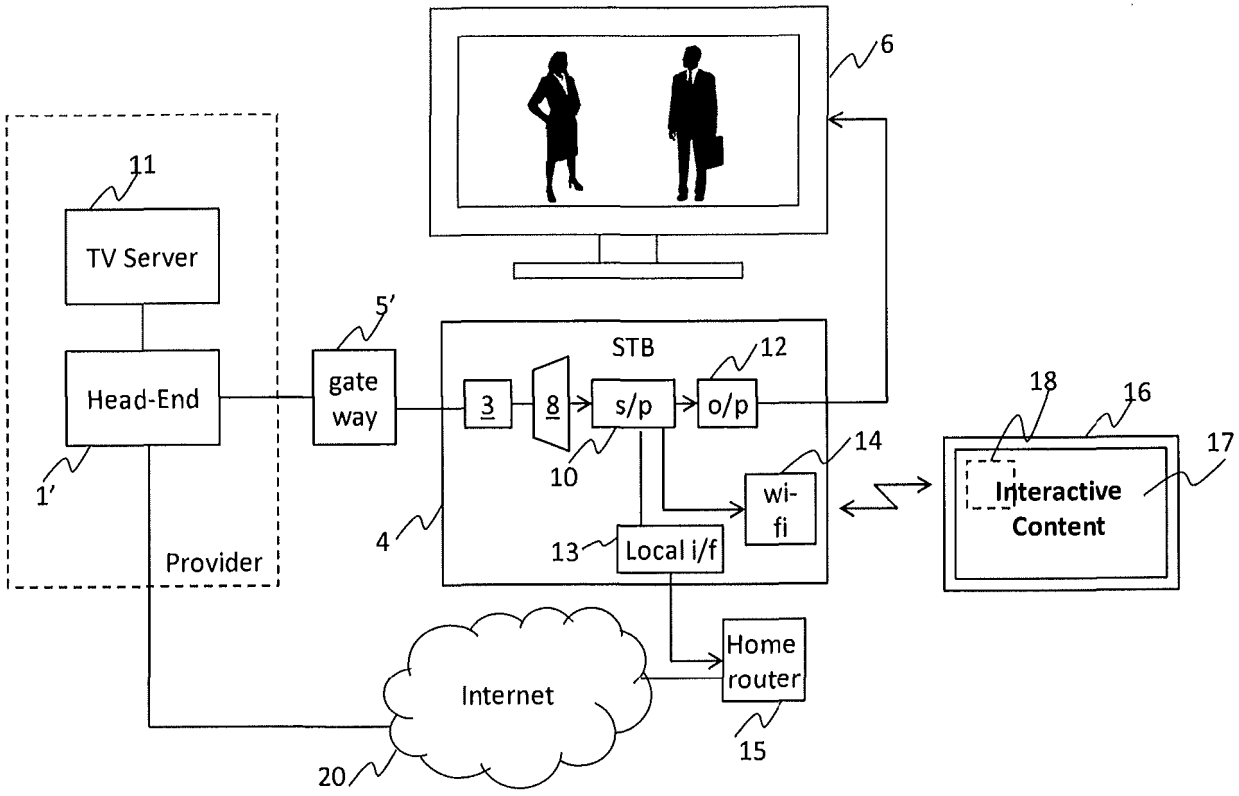

6
11
TV Server
Head-End
1'
Provider
5'
gate way
STB
3
8
s/p
o/p
12
10
4
13
Local i/f
wi-fi
14
18
16
17
Interactive Content
Internet
Home router
15
20

Figure 3

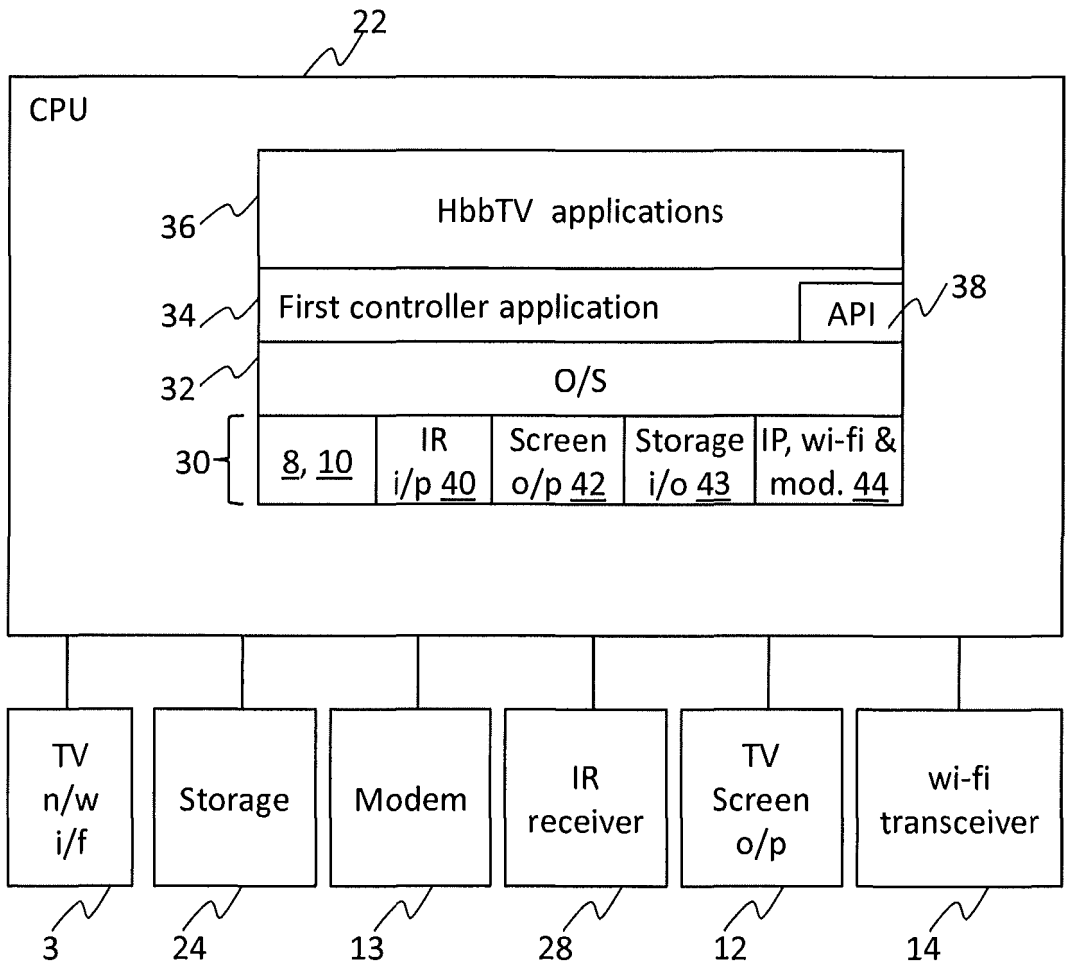

22
CPU
36
HbbTV applications
34
First controller application
API
38
32
O/S
30
8, 10
IR i/p 40
Screen o/p 42
Storage i/o 43
IP, wi-fi & mod. 44
TV n/w i/f
Storage
Modem
IR receiver
TV Screen o/p
wi-fi transceiver
3
24
13
28
12
14

Figure 4

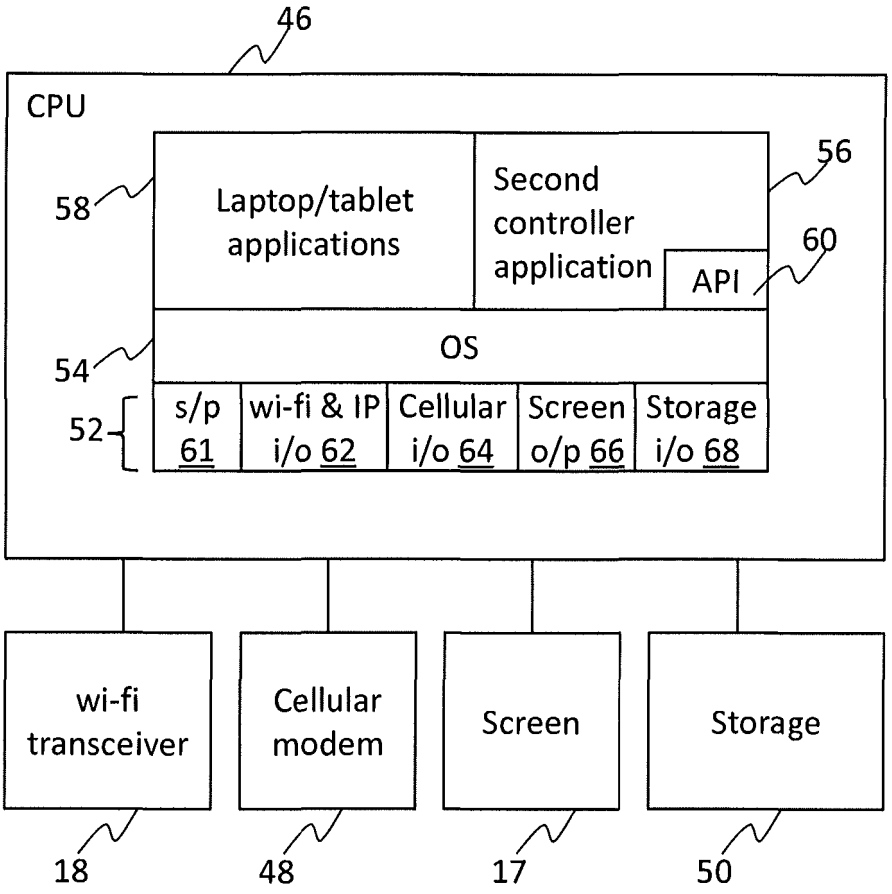

46
CPU
58
Laptop/tablet applications
Second controller application
56
60
API
54
OS
52
s/p 61
wi-fi & IP i/o 62
Cellular i/o 64
Screen o/p 66
Storage i/o 68
wi-fi transceiver
Cellular modem
Screen
Storage
18
48
17
50

Figure 5

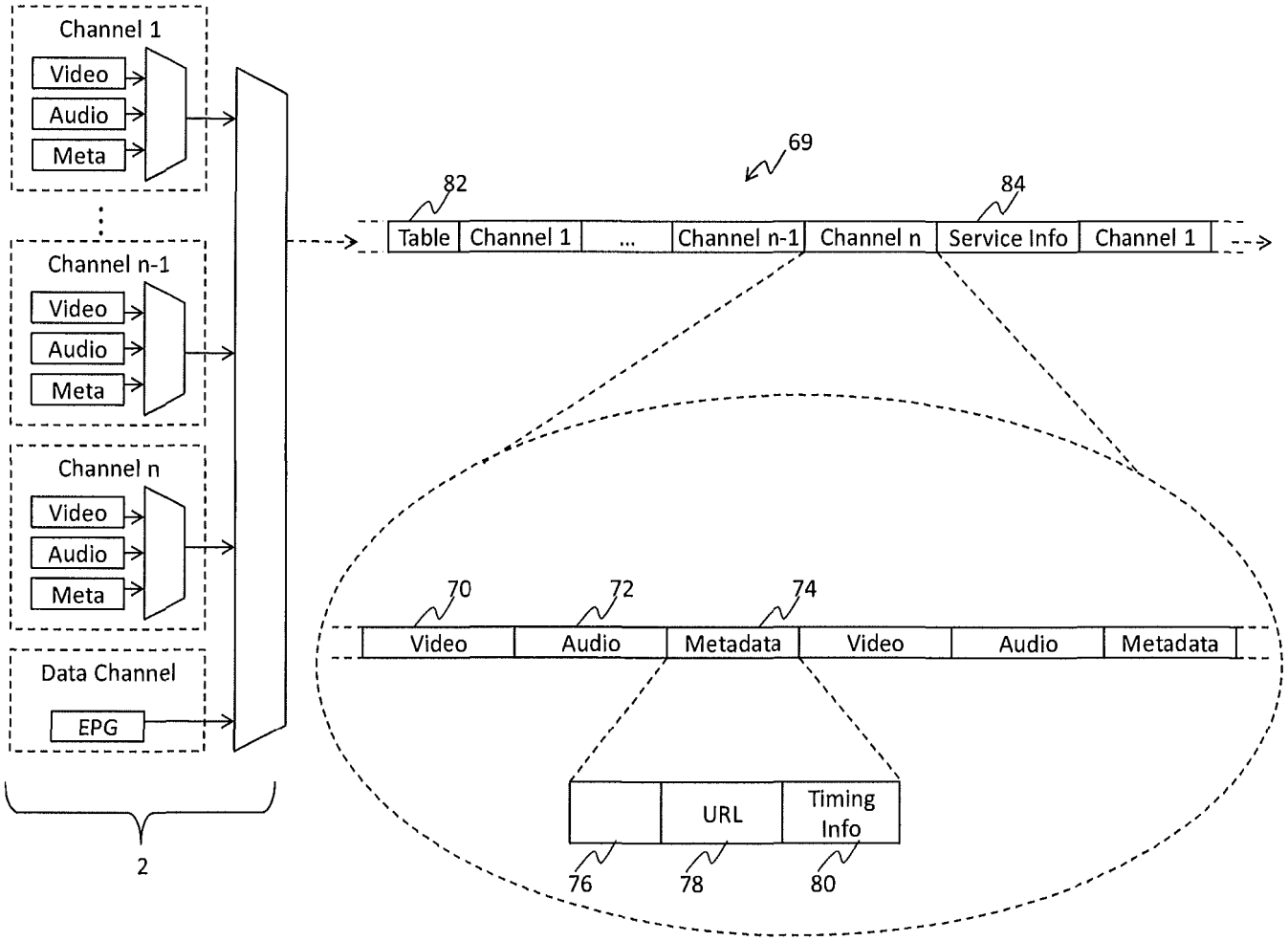

Channel 1
Video
Audio
Meta
Channel n-1
Video
Audio
Meta
Channel n
Video
Audio
Meta
Data Channel
EPG
2
69
82
84
Table
Channel 1
...
Channel n-1
Channel n
Service Info
Channel 1
70
72
74
Video
Audio
Metadata
Video
Audio
Metadata
URL
Timing Info
76
78
80

Figure 6

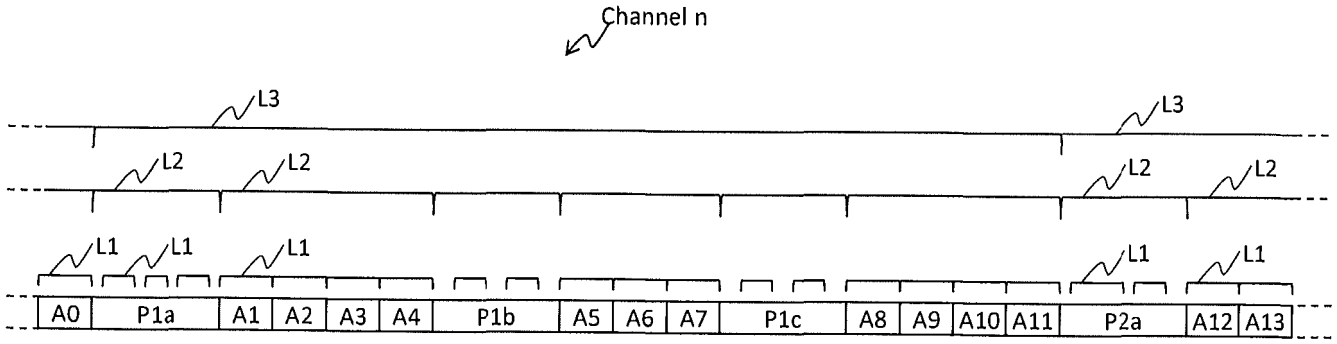


Figure 7a

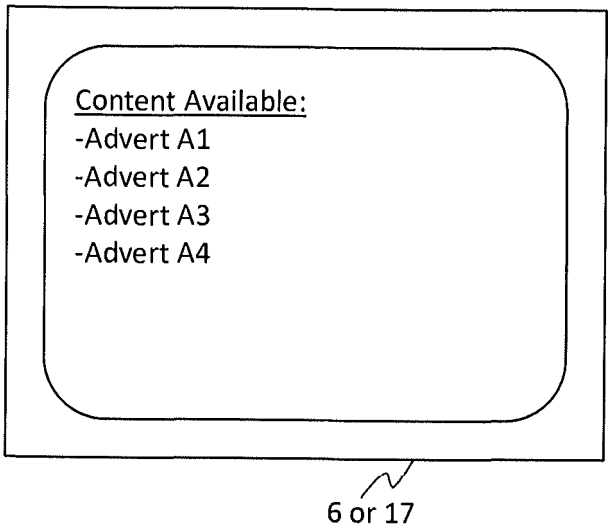
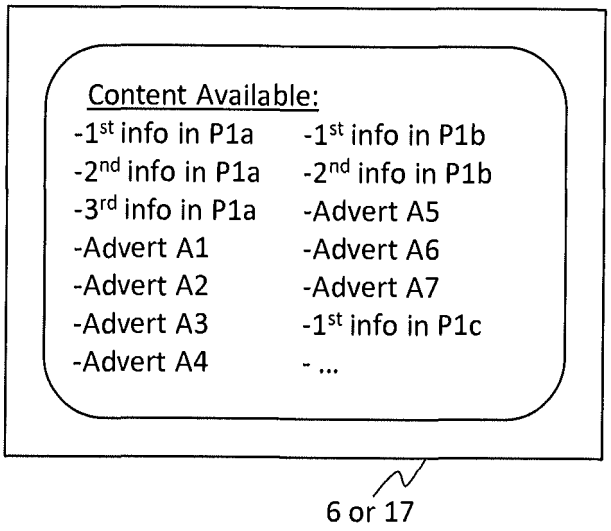


Figure 7b



The following term is a registered trademark and should be read as such wherever it occurs in this document:

HbbTV

Television System

Field of the Invention

The present invention relates to the processing of supplementary interactive content in a television system.

Background

A conventional television system is illustrated schematically in Figure 1a. The system comprises a television network 2 such as a satellite television network in which signals are broadcast wirelessly via one or more satellites, a terrestrial television network in which signals are broadcast wirelessly via one or more land-based repeater stations, or a cable television network.

The system further comprises a set-top box 4 and a television screen 6. Alternatively the components of the two devices 4, 6 can be combined into the same housing to form a television set, but for illustrative purposes the following will be described by reference to an arrangement comprising a separate set-top box 4 and screen 6.

The set-top box (STB) 4 comprises a television receiver having a receiving interface 3 in the form of one or more of: an input for connecting to a radio-frequency antenna 5 for receiving signals over a terrestrial television network, an input for connecting to a satellite dish for receiving signals over a satellite television network, and/or a cable input for receiving signals over a cable television network. The television receiver of the set-top box 4 further comprises a demultiplexer 8 having an input operatively coupled to the interface 3.

The network interface 3 is arranged to receive multiple concurrent television channels, at least in that the physical signals of multiple channels arrive concurrently at the location of the

interface. However, only a certain selected channel will be desired by the user. To this end, the demultiplexer 8 is arranged to receive an indication of the selected television channel from the user and to extract the data of that television channel for signal processing and output to the television screen 6. The interface 3 may be arranged to receive a plurality of different television channels on one or more frequency bands. On a given frequency band, the television channels may be interleaved in time into a transport stream comprising multiple channels in different interleaved time slots. In this case the demultiplexer 8 comprises a deinterleaver arranged to extract the data of the selected television program from its respective time slots (note therefore that channels interleaved into a transport stream are considered to be effectively concurrent for the purpose of this application). In the case of multiple frequency bands, the deultiplexer 8 comprises a television tuner arranged to tune to the frequency band of the selected television channel. It is also possible that both time and frequency division multiplexing are used, such that each of a plurality of frequency bands carries a different respective transport stream, the transport stream on each frequency band comprising a plurality of television channels. In this case the demultiplexer 8 comprises both a television tuner and a de-interleaver.

The set-top box 4 further comprises a signal processing module 10 having an input operatively coupled to the output of the demultiplexer 8, and a television screen output port 12 such as a coaxial output, SCART or HDMI port, etc. operatively coupled to the output of the signal processing module 10 (or in the case of a television set the output 12 is an internal connection to the television screen). The television channels will have been transmitted over the network 2 in encoded form, to compress the data of those channels into a smaller number of bits to save on network resources when transmitted over the television network 2. The signal processing module comprises a decoder arranged to decode the content of the selected television channel and thereby decompress the data for output to the screen 6 via the output port 12. The television channels may also have been transmitted in encrypted form to provide security, e.g. so that only authorised users can view them, in which case the signal processing module 10

comprises a decryption algorithm for decrypting the channel, e.g. given an appropriate decryption key.

The signal processing module 10 is preferably implemented in the form of a portion of executable program code stored on a storage medium of the set-top box 4 and arranged for execution on a processor of the set-top box 4. However, the option of some or all of its functionality being implemented in dedicated hardware circuitry is not excluded. The demultiplexer 8 may also be implemented wholly or partially in executable code, though in the case of a tuner it may comprise at least some dedicated tuner circuitry.

Thus a plurality of television channels are concurrently made available in multiplexed form, from which a selected channel is to be demultiplexed, decoded and output to a screen 6. Conventionally a user selects the desired channel by means of the television 6 or set-top box 4, e.g. using a dedicated infra-red remote control unit (not shown) associated with the television 6 or set-top box 4.

An arrangement consistent with that of Figure 1a may be represented schematically as shown in Figure 1b. Here a plurality of multiplexed television channels C are broadcast via a head-end 1 being a component of the television network 2, and received at an antenna or dish 5. The channels C are thus made available, still in multiplexed form, to the set-top box 4 (or TV set) connected to that antenna or dish 5 (note that the parallel lines in Figure 1b are schematic and the multiple channels are still multiplexed onto the same line). Figure 1b also illustrates the fact that a given antenna or dish 5 may be connected to multiple instances 4a, 4b of a set-top box 4 each connected to a respective screen 6a, 6b (or one or more of these could be an integrated TV set). Each of the one or more set-top boxes 4 or TV sets is equipped with its own respective demultiplexer 8 and signal processing module 10 so as to demultiplex and output its own respective selected one of the channels.

An alternative arrangement is shown in Figures 1c and 1d. Figure 1d illustrates an IP (Internet Protocol) multicast scenario. In this case a provider of an IP television service operates an IP head-end 1', which is connected to a server 11 storing IP based television content, and also connected to a home gateway 5' such as a wireless home router or other local router via a suitable connection. This connection between the IP head-end 1' and home gateway 5' may comprise a broadband phone line or a dedicated connection of the provider such as an optical or cable connection, or could comprise stretches of a combination of any of these. Further, a plurality of set-top boxes 4a, 4b and/or television sets are connected to the home gateway 5' via a wired or wireless connections. The IP head-end 1' thus makes a plurality of television channels available to the one or more STBs 4 or television sets via the home gateway 5'. In this way the IP based head-end 1', server 11 and connections to the home gateways provide an alternative form of television network.

As an additional service the IP television provider may also provide general Internet access onto the open Internet 20 via the connection between the home gateway 5 and the IP head-end 1', or alternatively the user may have to access the Internet via a separate connection and/or separate provider. If Internet access is via the provider's own head-end 1', the television network formed by the head-end 1', server 11 and connection to the gateway 5' may still be considered a private network distinguishable from the rest of the open Internet 20, for example in that all the nodes within the private television network are configured according to a dedicated IP television protocol or standard; and/or in that the television network forms a closed network to which access is restricted to only a certain set of subscribers (e.g. because a process of authenticating user credentials is required before the head-end 1' allows access to a particular gateway 5' or STB 4, and/or the gateway 5' or STB 4 requires a decryption key to decrypt the content from the television network).

Referring to Figure 1c, in the case of IP multicasting the set-top box 4 is similar to that shown in Figure 1a except that the interface 3 of the STB's television receiver comprises a modem and suitable packet protocol, and its demultiplexer 8 comprises a packet filter. Each STB 4 (or

television set) may request its own respective selected one of the multiple channels available from the IP head-end 1' via the home gateway 5', e.g. a first STB 4a requesting one channel and a second STB 4b on the same home network requesting another, different channel. The home gateway 5' therefore receives multiple selected channels c for the different respective STBs 4a, 4b. The home gateway 5' will comprise its own packet filter in order to attempt to direct only those packets required by the first STB 4a to the first STB 4a and only those packets required by the second STB 4b to the second STB 4b. However, in reality the home gateway 5' will not be 100% efficient at filtering out the packets destined for STB 4a from those intended for STB 4b and vice versa. Hence the first STB 4a requires a demultiplexer 8 in the form of a packet filter in order to discard the packets intended for the second STB 4b, and similarly the second STB 4b requires a packet filter in order to discard the packets intended for the first STB 4a (and so on if there are three or more television receiving devices connected to the home network).

A distinction between broadcast and multicast is that a multicast is a point-to-point transmission (albeit point-to-multipoint) whereby each item of content is transmitted to an identified address in response to a request for the content, the transmitter knowing the address and including that address in header information in the transmitted stream. A broadcast on the other hand is transmitted "indiscriminately" in that multiple television channels are provided to the location of a receiving interface without those television channels having been requested by any particular receiving terminal at that location (even if a subscription and decryption key are required to make meaningful use of the channels). Information identifying a destination address typically would also not be included in a broadcast.

Another possibility nowadays is that the user requests and receives a single specified channel "on demand" directly from a television provider over an IP network. In this case the television receiver comprises a suitable modem.

By whatever means the data is delivered, each television channel conventionally comprises one or more elementary streams in the form of a video stream and one or more audio streams (e.g. alternate language soundtracks). Subtitle streams are also common. A given television channel is defined by its user content, being a consistent stream of content from the perspective of the user, and may also be identified by a respective television channel identifier included in metadata carried in the multiplexed signal.

Furthermore, in some modern television systems one or more of the television channels may comprise embedded metadata associated with the channel, such as metadata defining interactive content of that channel. The metadata may be associated with a specific channel identifier. For example, in a "hybrid" television system such as HbbTV (Hybrid Broadcast Broadband TV), a set-top box or television set will be equipped with an interface for accessing the Internet, such as a wired modem or wireless transceiver connecting to a wireless router in the home. Metadata in the form of a URL can then be embedded in a broadcast channel, linking to supplementary content on the Internet. When a user activates a control at the relevant time during the program, the set-top box or TV set can then retrieve the supplementary content from a server via the Internet for display on the television screen, either replacing or in conjunction with display of the current program. For example this could be used in commercials or during product placement to link to further information on the advertised product. Another option is that the metadata may comprise a link that references content carried in the broadcast stream itself, as opposed to a server. Data streams carrying interactive content are typically referred to as "carousels".

Interactive content may have an interactive application associated with it running on the set-top box or television. The interactive application in HbbTV (and UK MHEG) can be (and usually is) automatically run when the channel is selected. For example this is what shows a red button in the corner of the screen. Normally the application then runs silently in the background until the user presses the red button (or such like) to display and interact with the associated interactive content. Although for radio channels, and theoretically on any channel, the

application may immediately go into a full screen interactive mode without this being specifically initiated by the user.

In addition to the metadata associated with particular respective channels, a broadcast may also include one or more separate data streams associated with the broadcast as a whole, i.e. associated with a set of channels and shared between all of those channels. These one or more data streams may be referred to as the "service information". This typically comprises an electronic program guide (EPG) which the user can view via his or her STB or TV.

Summary

One problem with interactive television systems is that there may be a delayed user reaction time between the display of certain video content on screen and the activation of the relevant user input attempting to summon the interactive content associated with that video content. For example if the user attempts to summon the interactive content associated with a particular commercial shortly before the end of that commercial, his or her delayed reaction time may result in the user instead summoning interactive content associated with a subsequent commercial or subsequent part of a program, or in the attempt simply being ineffectual.

Even when the user's hand-eye reaction time is good, there may still be a delayed interest in the interactive content relative to the main video content of the channel. For example a user may be interested in a product seen in a certain program or commercial during a program, but not enough to want to summon the associated interactive content until a later time, e.g. once he or she has finished viewing the program.

Another problem is that in current interactive television systems there is an assumption that interactive content accessed via the set-top box or television set is also to be displayed on the television screen of that box or set at the same time as the main video content to which it

relates, during the program or commercial with which that interactive content is associated, e.g. being overlaid on or replacing the current main video content on the screen. However, the inventors believe this is intrusive, i.e. it obscures the main video content of the channel (the actual program being viewed). This is especially so when there are multiple viewers present but only one of them is interested in the interactive content whilst others would prefer to continue to concentrate on the main program.

It is an aim of the present invention to provide a solution to at least one and preferably both of the problems of delayed user reaction and non-intrusive provision of interactive content.

According to one aspect of the present invention, there is provided a method comprising: at a television receiver, receiving a television channel comprising main video content, and receiving metadata relating to a plurality of items of interactive content each associated with the main video content of said channel at different respective times; outputting at least a portion of the main video content to a screen; at processing apparatus of a user terminal, determining a hierarchical time structure for the received television channel relative to the main video content, the hierarchical time structure comprising a plurality of nested levels in the form of a lowest level and at least one higher level ordered from lower to higher level, each level comprising a plurality of time windows, each time window of the lowest level corresponding to a different respective one of said items of interactive content, and each time window of each of the one or more higher levels corresponding to a different respective plurality of the time windows of its next lower level in the hierarchical time structure; and receiving user operations at a user terminal; wherein a first one of said user operations accesses on screen the item of interactive content associated with a current lowest level time window, being one of said lowest level time windows defined as current relative to the output of the video content based on the first user operation; and wherein at least a second one of said user operations generates a list of the items of said interactive content corresponding to a plurality of lower level time windows within a current higher level time window, being one of said higher level time

windows defined as current relative to the output of the video content based on the second user operation.

In embodiments the time structure may be defined in said metadata, the metadata may be embedded in the received television channel, and the determination of said time structure may comprise reading the time structure from the television channel received at said television receiver.

The method may comprise outputting the list to a screen, receiving a user selection of a selected one of the items from said list, and accessing the selected item on screen

The second user operation may cause the list to be stored on a memory medium; and the method may comprise outputting the list to a screen following expiry of the current higher level time window, receiving a user selection of a selected one of the items from said list, and accessing the selected item on screen, the list thus enabling deferral of the interactive content.

The method may comprise detecting a setting determining whether the list is to be stored or displayed immediately in response to the second user interaction, and conditionally storing the list in dependence on said setting.

In one particularly advantageous embodiment, said receipt of the television channel and metadata may be at the television receiver of a first user terminal, and said output of main video content may be to a screen of the first terminal; the second user operation may cause one of (i) the list to be generated at the first terminal and forwarded to a second user terminal via a wireless link, and (ii) information on said time structure to be forwarded to the second terminal via the wireless link and the list to be generated at the second terminal; and the method may comprise outputting the list to a screen of the second terminal, receiving a user selection of a selected one of the items from said list at the second terminal, and accessing the selected item on the screen of the second terminal.

As mentioned, there is an assumption that interactive content accessed via the set-top box or television set is also to be displayed on that television screen of that box or set. But for reasons discussed above the inventors believe this is intrusive.

Some developers have provided EPG applications that can run on a tablet style computer, but these simply operate by downloading a separate EPG to the tablet from a web server via the tablet's own internet connection. Therefore these applications do not provide access to true interactive content, i.e. interactive content that can be defined by the broadcaster or provider of the channel and delivered along with the channel itself. Furthermore, such applications require cumbersome mechanisms to try to synchronise the guide with the actual timing of the programming. For example one existing system requires a number of sample frames of the program to be provided to the server where a video pattern matching algorithm is applied to try to determine what is being watched. This is cumbersome, prone to error, and may involve an undesirable time lag.

On the other hand, this embodiment of the present invention receives a television channel comprising interactive content at the television receiver of a first terminal along with the channel itself, including the main video content, but displaces the interactive content from the first terminal to a screen of a second terminal whilst the main video content of the channel continues to be played out through the screen of the first terminal. This is one way in which true interactive content can be provided in a non-intrusive manner.

In further embodiments, the method may comprise operating a system comprising the first user terminal and second user terminal in two different modes: a first mode in which the list is output to the screen of the first terminal and a second mode in which the list is output to the screen of the second terminal by said wireless link.

The mode may depend on whether the second terminal is detected to be present on said wireless link.

The mode may depends on whether the second user operation is performed at the first terminal or the second terminal.

The first terminal may be one of: a television set comprising said screen of the first terminal, and set-top box for plugging into said screen of the first terminal.

The second terminal may be a portable terminal. The second terminal may be one of a tablet and a laptop computer.

The first user interaction may comprise a single press of a remote control unit, and the second user operation may comprise a double press of said button.

The metadata may comprise a link to a server, and accessing the interactive content may comprise retrieving the interactive content from the server via a packet-based network based on the link.

The method may comprise sending to an address a message comprising links to the items of interactive content in the stored list.

The television receiver may comprise: a receiving interface at which a plurality of concurrent multiplexed television channels are concurrently made available from a television network, each television channel comprising a respective video stream, and a demultiplexer which demultiplexes the selected television channel from amongst said television channels.

The receiving interface may comprise an input from at least one of a satellite dish and a radio-frequency antenna, at which the plurality of television channels are made available on a

plurality of different frequency bands, and the demultiplexer comprises a television tuner which tunes to the frequency band of the selected television channel.

The television receiver may receive the television channel from a private television network.

According to another aspect of the present invention, there is provided a computer program product comprising code embodied on a non-transitory computer-readable medium and configured so as when executed on a processor to perform operations according to any of the above method features.

According to another aspect of the present invention, there is provided a terminal for use in a system in which a television channel comprising main video content is received at a television receiver along with metadata relating to a plurality of items of interactive content each associated with the main video content of said channel at different respective times, and at least a portion of the main video content is output to a screen; the terminal comprising: a processing apparatus configured to determine a hierarchical time structure for the received television channel relative to the main video content, the hierarchical time structure comprising a plurality of nested levels in the form of a lowest level and at least one higher level ordered from lower to higher level, each level comprising a plurality of time windows, each time window of the lowest level corresponding to a different respective one of said items of interactive content, and each time window of each of the one or more higher levels corresponding to a different respective plurality of the time windows of its next lower level in the hierarchical time structure; and a user input for receiving user operations; wherein a first one of said user operations accesses on screen the item of interactive content associated with a current lowest level time window, being one of said lowest level time windows defined as current relative to the output of the video content based on the first user operation; and wherein at least a second one of said user operations generates a list of the items of said interactive content corresponding a plurality of lower level time windows within a current

higher level time window, being one of said higher level time windows defined as current relative to the output of the video content based on the second user operation.

In embodiments the terminal may be further configured to perform operations in accordance with any of the above method features.

Brief Description of the Drawings

For a better understanding of the present application and to show how it may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1a is a schematic block diagram of a television system,
Figure 1b is another schematic block diagram of a television system
Figure 1c is a schematic block diagram of another television system,
Figure 1d is another schematic block diagram of a television system,
Figure 2a is a schematic block diagram of an improved television system,
Figure 2b is a schematic block diagram of an improved television system,
Figure 3 is a schematic block diagram of a first terminal,
Figure 4 is a schematic block diagram of a second terminal,
Figure 5 is a schematic representation of a television transmission with embedded metadata,
Figure 6 is a schematic representation of a time structure of a television channel,
Figure 7a is a schematic illustration of a user interface, and
Figure 7b is another schematic illustration of a user interface.

Detailed Description of Preferred Embodiments

A time structuring scheme for processing interactive content in accordance with preferred embodiments of the present invention will now be described in relation to Figures 6, 7a and 7b.

Examples of a preferred system for implementing the scheme in accordance with preferred embodiments will then be described in relation to Figures 2a, 2b, 4 and 5.

Figure 6 represents a portion of a timeline of a demultiplexed television channel "n". The television channel comprises a plurality of divisions in time, typically in the form of a plurality of commercials A0, A1, A2, ..., A12, A13, etc. and a plurality of programs P1, P2, etc. Each of the programs may be divided into a plurality of parts, e.g. P1 being divided into three parts P1a, P1b and P1c, and program P2 being divided into parts P2b, P2b, etc. The commercials A0...A13 are interspersed in time between the parts of the programs P1a, P1b, P1c, P2a, etc.

It will be appreciated that the particular pattern in the illustrated portion of the television channel in Figure 6 is only an example for illustrative purposes, and in other scenarios different numbers of commercials A may be interspersed in different patterns between different numbers of programs or program parts P. Note also that whilst in places terms like "program" and "film" may sometimes be used separately, most broadly the term "program" can cover any portion of the main video content of a television channel (and any associated main audio content), e.g. TV shows, films, public information, etc.

Each of a plurality of the commercials A and/or program parts P is associated with a different respective item of interactive content.

Preferably the interactive content is defined by metadata embedded in the television channel (not shown in the representation of Figure 6 but see the discussion of Figure 5 which follows below). In one preferred embodiment the user is in possession of a terminal that is both equipped to receive television channels and is equipped with an interface to a packet-based network such as the Internet. In this case the metadata may comprise a URL (Universal Resource Locator) or other such network locator which links to interactive content stored on a server of the Internet or other packet-based network. The viewer can then access the interactive content by activating a suitable user input and the terminal will then retrieve the

interactive content from the server via its connection to the Internet, based on the metadata extracted from the television channel. For example this could link to a website during a commercial A or a product placement in a program part P, such that a user can find out more about a product or purchase the product online; or the metadata could link to information on a particular location, cookery item, actor, etc. seen on screen in a program P; or could link to an online application associated with a program P.

Alternatively or additionally, the metadata embedded in the channel may refer to interactive content carried in the carousel of the multiplexed transport stream, e.g. supplementary text, graphics or even a simple application being provided to the user terminal in question in the television channel itself.

As illustrated in Figure 6, a scheme according to the present invention involves determining a hierarchical time structure for a received television channel, e.g. "channel n", the hierarchical time structure comprising a plurality of time windows L1, L2, L3 of different sizes at different hierarchical levels. Three levels are shown in Figure 6 for illustrative purposes but it will be appreciated that other numbers of levels could be used, from two upwards.

At the first (lowest) hierarchical level are the time windows L1 associated with each individual item of interactive content.

For example, a different respective time window may be assigned to each commercial A, and one or more different respective time windows may be associated with one or more information points or product placements within each program or part of a program P.

These lowest level time windows L1 are preferably defined in the metadata embedded in the television channel, either implicitly by the position or order of the metadata relative to the other interleaved content or explicitly by means of synchronisation data comprised within the metadata which is used to synchronise to synchronisation data included in the main video

and/or audio content. The time windows L1 are thus defined relative to the timing of the main video content (even if vicariously via synchronisation with the audio content). The lowest level time windows L1 define the time period for which the interactive content is valid as interactive content (even if it remains available online via other means afterwards). That is, the system is arranged such that, on condition that the user activates the relevant user input at a time consistent with the current time window and its associated current main video content (current relative to the play out of the main content from the relevant screen), then the user will be automatically directed to the corresponding interactive content for which that window is defined. Otherwise the activation of the user input will either do nothing or summon interactive content associated with a different window.

A suitable user terminal of the user will be arranged to extract the necessary timing information to determine the respective corresponding time window for which each item of interactive content is valid.

A computer representation of a hierarchical time structure comprising one or more successively higher levels is then constructed, e.g. levels L2 and L3 in Figure 6.

The levels L1, L2, L3 have an order from lowest to highest representing increasingly wide windows in time, i.e. decreasing time resolution; so the lower level or levels represent smaller, more finely defined time windows and the higher level or levels represent larger, less finely defined time windows. Each time window of a particular higher level in the hierarchy covers a plurality of smaller time windows of the level immediately beneath. So in the example of Figure 6, the second level comprises a plurality of second level time windows L2 each of which covers a different respective plurality of the lowest level time windows L1 (hence encompassing a plurality of the items of interactive content associated with those lowest level time windows L1). In turn, a third level may comprise a plurality of third level time windows L3 each of which covers a different respective plurality of the next lowest level time windows, the second level time windows L2.

For example each second level time window L2 may be assigned to an entire commercial break comprising multiple commercials A, or to the group of all the information points or product placements within a given part of a program P. Each third level time windows may then be assigned to a different respective program P1, P2, etc. covering all the commercial breaks and parts within a whole program's scheduling slot. The hierarchy could even continue upwards, e.g. to a fourth level covering a whole series or whole group of programs.

Note that only some of the windows in Figure 6 are labelled explicitly but it will be appreciated that the reference numerals L1, L2 and L3 are intended to refer to all the illustrated time divisions (windows) of the respective level. Note also that the lowest level time windows L1 are only considered the lowest in the sense that they are associated with the lowest level in the scheme in question. It is not excluded that a finer level of resolution exists for some other supplemental or parallel scheme.

In embodiments the one or more higher levels L2, L3 of the hierarchical time structure may also be determined at least partially based on metadata embedded in the received television channel, as will be discussed in more detail in relation to Figure 5. In this case the time structure will be generated by a suitably configured user terminal based on the relevant metadata extracted from the received television channel. Alternatively however the levels of the time structure could be determined by some other means, e.g. relative to a known schedule such as an EPG or online schedule, or based on predetermined divisions in time.

Either way, the hierarchical time structure then allows the user to access the interactive content in a more sophisticated way that is less tied to the particular moment at which the corresponding main video content is seen on screen. As discussed above, using the momentary, reaction-based methods employed in existing schemes, a user can only summon the single item of content associated with the current moment in the channel. This requires the user's reaction time to be sufficient, and that he or she is at that moment interested enough in the interactive

content to be prepared to allow it to intrude upon the main video content of the program currently being displayed on screen.

On the other hand, using the present invention the user will be provided with at least two potential user operations for summoning interactive content associated with a television channel: a first user operation and a second user operation. In embodiments the first user operation comprises a single press of a particular button on a remote control unit (RCU) associated with a relevant one of the user's terminals, e.g. a particular coloured button such as the yellow or red button. The second user operation may comprise a double press of that same button, i.e. two presses within a certain predetermined separation in time. However these are only example options and the user operations could comprise any suitable action via any suitable user input, e.g. two separate buttons on the RCE or certain actions or buttons operated via a touch screen.

When the first user operation is detected, this simply summons the single item of interactive content associated with the current video output of the channel in the conventional manner.

However, when the second user operation is detected, this automatically generates a list of a plurality of the items of interactive content covered by one of the higher level time windows, e.g. L2 or L3.

The list can then be viewed by the user on a screen to see all the items of interactive content that would have been available and/or are going to be available in the current higher level time window, e.g. L2 window (current relative to the play out of the main video content from the relevant screen). The list also acts as a menu, enabling the user to select one of the listed items of interactive content to be accessed on screen, e.g. by selecting using arrow keys and an on-screen cursor or by pointing via a touch screen.

An example of a list of items within a second level time window L2, as might be seen by a user on screen, is illustrated schematically in Figure 7a.

In embodiments a first instance of the second user operation could progress up to the second level, whilst further instances of the second user operation or a third user operation could progress to layers even further up the hierarchy. For example a double press of a button on the RCU could progress one level up the hierarchy to the second level L2 and a triple press could progress higher up the hierarchy to the third level L3 (a triple press effectively being a repeat of the operation of pressing again within a predetermined time separation). Again the list acts as a menu, enabling the user to select one of the listed items of interactive content to be accessed on screen, e.g. by selecting using arrow keys and an on-screen cursor or by pointing via a touch screen.

An example of a list of items within a second level time window L2, as might be seen by a user on screen, is illustrated schematically in Figure 7b.

If the relevant metadata is available for future items in the current higher level time window, e.g. because it is provided in advance or the channel is played out with a delay relative to its receipt, then the list may include one or more future items. Alternatively the list may only comprise current and past items. For example if the user summons the list during commercial A3, the list may comprise all of A1 to A4 if that data is available, or otherwise may only comprise A1 to A3. In further embodiments, if the list is summoned just after the end of a higher level time window, perhaps when only one item in the new window at the level in question is available, the list may revert back to the previous time window at that level in the hierarchy . For example if the user summons the list within the first commercial A8 of one of the second level windows, he or she may instead be provided with a list of the items that occurred during P1c, or a list of those items plus A8. In another example, if the user summons the list during the first item in the first part P2a of a new program, he or she may be provided

with a list of all the items in all parts of the previous program P1 (preferably including its commercial breaks), perhaps also adding the first item of P2a to the list as well.

In one particularly advantageous embodiment the list is not summoned on screen immediately when the second user operation Is performed, but is instead automatically stored on a suitable memory medium such as a magnetic hard drive, flash memory or RAM of or associated with a terminal of the user. The list can then be automatically or manually retrieved following at least the expiry of the current higher level of time window for which that list was generated, and perhaps following the expiry of the whole program, or just when the user is interested or finds it convenient to do so. This may be less intrusive than immediate summoning.

The user may receive the television channel including the metadata defining the interactive content at a television receiver of a first terminal, e.g. a set-top-box 4 for plugging into its accompanying television screen 6 or a television set having the television receiver and screen integrated into the same housing. In one optional embodiment, the first terminal 4 is also provided with a wireless link such as a wi-fi or bluetooth connection to a second terminal 16, e.g. a portable terminal such as a tablet type computer or laptop computer. In this case, the embodiments of the invention may displace at least part of the functionality described above to the second terminal 16, preferably at least so that the list is displayed on the screen 17 of the second terminal 16 rather than the screen 6 of the first terminal 4, and/or so that the interactive content itself is accessed via the screen 17 of the second terminal 16. Thus the interactive content need not intrude on the main video content of the channel being played out through the television screen 6 of the first terminal 4.

Where an action, step, output or operation of the hierarchical listing scheme is described above as being on screen or performed by or at a terminal, or such like, this could refer to either screen and/or either terminal.

For example the timing metadata could be extracted and the hierarchical time structure and list generated at the first terminal 4, and the generated list could then be forwarded to the second terminal 16 via the wireless link so that the display of the list and selection of the interactive content is displaced to the second terminal 16. Alternatively the metadata could be extracted at the first terminal 4 but forwarded in raw form to the second terminal 16 for the hierarchical timing structure and list to be generated there, or the whole channel could even be forwarded to the second terminal 16 over the wireless link for the metadata to be extracted at the second terminal. Alternatively information on the hierarchical timing structure could be forwarded over the wireless link on part processed form to be completed at the second terminal 16.

Further, each of the first user operation and/or second user operation could be received at either the first terminal 4 or second terminal 16 (including the option of receiving the user operation via a remote control unit of one of those terminals). If the user operation is performed at a different one of the first and second terminals 4, 16 than generates the list and/or hierarchical time structure, occurrence of the relevant operation may be signalled over the wireless link between the two using a suitable control signalling protocol e.g. for signalling between application programming interfaces (APIs) of first and second controller applications running on the first and second terminals 4, 16 respectively.

In further embodiments, the system formed by the first and second terminals 4, 16 may be operable in two different modes: one in which the list is accessed via the first terminal and one in which the list is accessed via the second terminal. The controller application on one or both of these may be configured to determine which mode to operate in based on whether the second terminal is present on the wireless link (e.g. within range of the first terminal, having wireless capability turned on, or being present on the same wireless local area network). Alternatively or additionally the mode may depend on which of the first and second terminals receives the second user operation summoning the list.

A television system for implementing a time structuring scheme such as that of Figures 6, 7a and 7b in accordance with an example implementation of the present invention is illustrated schematically in Figure 2a.

As in Figure 1a the system comprises a television network 2 such as a satellite television network in which signals are broadcast wirelessly via one or more satellites, a terrestrial television network in which signals are broadcast wirelessly via one or more land-based repeater stations, or a cable television network.

The system further comprises a first user terminal in the form of a set-top box 4, and a television screen 6. Alternatively the components of the two devices 4, 6 can be combined into the same housing to form a television set, but again for illustrative purposes the following will be described by reference to an arrangement comprising a separate set-top box 4 and screen 6.

In addition, the system may optionally further comprise a second user terminal 16 in the form of a portable computer, such as a laptop computer or more preferably a tablet style computer. The following may be described in terms of a tablet for illustrative purposes, but it will be appreciated that other kinds of computer could equally be used as the second terminal 16.

If present in the system, the second terminal 16 is a separate terminal than the first terminal 4, by which is meant that they are separate units, i.e. housed within a separate housing (casing) and having separate hardware resources such as separate power supplies and separate processors, and each being capable of operating autonomously.

The set-top box (STB) 4 comprises a television receiver having an interface 3 in the form of one or more of: an input for connecting to a radio-frequency antenna for receiving signals over a terrestrial television network, an input for connecting to a satellite dish for receiving signals over a satellite television network, and/or a cable input for receiving signals over a cable

television network. The television receiver of the set-top box 4 further comprises a demultiplexer 8 having an input operatively coupled to the interface 3.

The network interface 3 is arranged to receive multiple concurrent television channels in the sense described above in relation to Figures 1a and 1b; and the demultiplexer 8 is arranged to receive an indication of the selected television channel from the user and to extract the data of that television channel for signal processing and output to the television screen 6. The set-top box 4 further comprises a signal processing module 10 having an input operatively coupled to the output of the demultiplexer 8, and a television screen output port 12 such as a coaxial output, SCART or HDMI port, etc. operatively coupled to the output of the signal processing module 10. The signal processing module comprises a decoder arranged to decode the content of the selected television channel for output to the screen 6 via the output port 12, and may also comprise a security module for decrypting the selected television channel before output.

Again, the signal processing module 10 is preferably implemented in the form of a portion of executable program code stored on a storage medium of the set-top box 4 and arranged for execution on a processor of the set-top box 4. However, the option of some or all of its functionality being implemented in dedicated hardware circuitry is not excluded. The demultiplexer 8 may also be implemented wholly or partially in executable code, though in the case of a tuner it may comprise at least some dedicated tuner circuitry.

In addition, the set-top box 4 comprises another wireless transceiver 14 being of a kind other than that formed by the interface 3 and demultiplexer 8, i.e. other than a television receiver for receiving signals over the television network 2. Preferably the transceiver 14 is a short range or ad-hoc wireless transceiver such as a wi-fi or Bluetooth transceiver, as might be used to connect to a home network or other local area network (LAN). The following may be described in terms of a wi-fi transceiver for illustrative purpose, but it will be appreciated that other kinds could be used for the additional transceiver 14.

Furthermore, the set-top box may comprise an interface to a wide area internet (inter-network) 20 such as the Internet. This interface may be via a separate local wired interface 13 in the set-top box 4, e.g. to a local network element 15 which connects onwards to the internet 20 via a telephone land line or other suitable connection. The local network element may comprise an ethernet hub 15 and the interface 13 may comprise an ethernet interface connecting to that hub. Alternatively or additionally, a local network element 15 may comprise a wireless router and the set-top box 4 may be arranged to connect to the Internet 20 via the wireless transceiver 14 and wireless router 15 on a home or local area network. The wireless access and router functionality of the element 15 could be combined into one unit or implemented in separate units.

Turning to the optional second terminal 16, this comprises a wireless transceiver 18, e.g. wi-fi or Bluetooth, to complement the wireless transceiver 14 on the first terminal 4, allowing a wireless connection to be established between the first and second terminals 4, 16. This wireless connection 14, 18 may be via one or more intermediate elements such as the wireless home router 15, e.g. in the case where the terminals 4, 16 communicate on a wireless home network such as a wi-fi network. Alternatively the wireless connection 14, 18 could be direct, e.g. in the case of a Bluetooth. The second terminal 16 also comprises its own screen 17.

The second terminal 16 may also be arranged to connect to the Internet 20. The second terminal 18 may be operable connect to the Internet 20 via its wireless connection with the first terminal 4, i.e. via the wireless transceivers 18 and 14 and the wired modem 13 on the first terminal 4. For example this could be the case if the transceivers 14, 18 comprise Bluetooth transceivers. More preferably however, the second terminal 16 may be operable to connect to the Internet 20 via a separate wireless connection between the wireless transceiver 18 and the home router 15, e.g. if the transceivers 14, 18 comprise wi-fi transceivers on a wi-fi home network; or indeed by a separate cellular connection.

An alternative arrangement is shown in Figure 2b. Here the broadcast television network 2 and antenna 5 are replaced (or supplemented) with a gateway 5' and IP television network formed by an IP head-end 1', a connection between the head-end 1' and a gateway 5', and television channel server 11 storing the television channel content and being connected to the head-end 1'. The components 1', 5' and 11 are arranged in a manner analogous to that described in relation to Figures 1c and 1d. The set-top box 4 may be similar to that described in relation to Figure 2a, except that its television receiver comprises a receiving interface 3 in the form of a suitable modem and IP protocol, and a demultiplexer 8 in the form of a packet filter.

In one embodiment the connection between the gateway 5' and the receiving interface 3 of the set-top box 4 may be a dedicated connection such as a cable or optical connection or to a dedicated television network delivering television services via IP or other such packet protocol, and the television interface 3 may comprise a corresponding dedicated TV modem. In this case the set-top box 4 preferably comprises a separate interface 13 or 14 providing access to the Internet 20. In an alternative embodiment, as an additional service the television provider may enable Internet access via the connection between the interface 3, gateway 5' and head-end 1'. In this case the television interface 3 may comprise a more generic modem. The set-top-box may or may not comprise a separate generic interface 13 or 14 for accessing the Internet 20 directly via a different provider.

In either embodiment, if the second terminal 16 is involved it may be operable to access the internet 20 via its wireless transceiver 18 and one or both of the set-top box 4 or the wireless hub or router 15. When via the set-top box 4, this may be via the wireless transceiver 14 and one or both of the interfaces 3, 13 or 14.

In the embodiment where Internet access is provided via the connection between the interface 3, gateway 5' and head-end 1', the television network formed by the head-end 1', server 11 and connection to the gateway 5' may still form a separate, private network that is distinguishable from the rest of the open Internet 20. This may be manifested in that each of the network

elements or nodes of the private television network such as the head-end 1', server 11 and gateway 5' are configured according to a special, dedicated IP standard or protocol. Alternatively or additionally this may be manifested in that the private network is restricted to a defined subset of users (smaller than the total number of users of the Internet 20), who may be referred to as subscribers. For example an element of the television network such as the head-end 1' or server 11 may maintain a list of subscribers and be configured to only supply content and/or accept requests from terminals 4 or gateways 5' having an address corresponding to a listed subscriber, and/or the user of a terminal 4 may be required to submit credentials such as a username and/or password and thereby participate in an authorisation procedure whereby an element of the television network such as the head-end 1' or server 11 may verify whether the credentials correspond to a listed subscriber and allow access to television content on that condition. Another possibility is that the private television network may distribute television content that is encrypted with one ore more encryption keys (e.g. a different respective key for each channel or set of channels), such that only those boxes 4 or gateways 5' that have been provided with a corresponding decryption key are able to access that content.

Further details of the first terminal 4, e.g. STB, are shown schematically in Figure 3.

The first terminal 4 comprises a processor (CPU) 22 in the form of one or more processing cores, and a non-transient (non-volatile) storage medium 24 such as a magnetic storage medium (hard drive) or electronic storage medium (e.g. flash memory) operatively coupled to the processor 22. The first terminal 4 may further comprises a local wired interface 13 such as an ethernet interface, an infra red (IR) receiver 28 for receiving control signals from an IR remote control unit, the screen output port 12 (or in the case of a TV set an internal connection to the screen 6), the wi-fi or other such local wireless transceiver 14, and the television interface 3 to the TV network 2 (but not necessarily all of these together).

The storage medium 24 stores a plurality of portions of executable program code, arranged for execution on the processor 22 (and shown schematically within the processor 22 in Figure 3 to represent running on the processor).

The program code may be considered to comprise an input-output (i/o) layer 30, an operating system layer 32, a middleware layer 34, and an application layer 36. The application layer 36 comprises one or more hybrid TV applications, e.g. HbbTV applications, such as a TV user interface application and further applications allowing additional functionality like web access and interactive services to be accessed via the set-top box 4 and/or television 6. The middleware layer 34 comprises a first television controller application in accordance with a preferred embodiment of the present invention, the function of which will be described shortly. The i/o layer 30 comprises a plurality of signal processing algorithms and drivers allowing the applications 34, 36 to communicate with the hardware resources 3, 12, 13, 14, 24 and 28, mediated via the operating system 32. The i/o layer 30 comprises the signal processing code 10 and de-multiplexing code 8 (in embodiments in addition to demultiplexing circuitry) for receiving a television channel from the TV network 2, an IR interface driver 40 for receiving signals from the remote control unit, a TV screen driver 42 for outputting video and graphics to the TV screen 6, a storage driver 43 for communicating with the storage device 24, and an IP protocol (or such like) and associated hardware drivers 44 for communicating with the second terminal 16 and/or router 15 via the wireless transceiver 14 and/or for accessing the internet via wired interface 13.

Further details of the optional second terminal 16, e.g. tablet style touch screen computer, are shown schematically in Figure 4.

The second terminal 16 comprises a processor (CPU) 46 in the form of one or more processing cores, and a non-transient (non-volatile) storage medium 50 such as a magnetic storage medium (hard drive) or electronic storage medium (e.g. flash memory) operatively coupled to

the processor 46. The second terminal 16 may further comprises a cellular modem 48, screen 17, and the complementary wi-fi or other such local wireless transceiver 18.

The storage medium 50 stores a plurality of portions of executable program code, arranged for execution on the processor 46 (and shown schematically within the processor 46 in Figure 4 to represent running on the processor).

This program code may be considered to comprise an input-output (i/o) layer 52, an operating system layer 54, and an application layer 56, 58. The application layer comprises one or more conventional applications 58 such as a web browser, games, email client etc. The application layer on the second terminal 16 also comprises a second television controller application 56 to complement the first television controller application 34 on the first terminal 4 in accordance with a preferred embodiment of the present invention, the function of which will be described shortly. The i/o layer 52 comprises a plurality of signal processing algorithms and drivers allowing the applications 56, 58 to communicate with the hardware resources 17, 18, 48 and 50, mediated via the operating system 54. The i/o layer 52 comprises a screen driver 66 for outputting video and graphics to the computer screen 17, a storage driver 68 for communicating with the storage device 50, a wi-fi transceiver driver and IP protocol (or such like) 62 for communicating with the first terminal 4 and/or router 15 via the wireless transceiver 18, a signal processing module 61, a cellular modem driver and protocol stack 64 for communicating with a cellular network, e.g. 3GPP network, so as to engage in calls or as an alternative route for internet access.

The middleware controller application 34 may comprise an application programming interface (API) 36 facilitating communication with the complementary second controller application 56 via the operating system 54 and/or any other relevant protocols of the second application. Similarly, the second controller application 56 may comprise an API 60 facilitating communication via the operating system 30 and/or any other relevant protocols on the first terminal 4.

In one embodiment of the present invention, only the first terminal 4 may be present and not the second terminal 16. In this case, when executed on the processor 22 of the first terminal 4 the first controller application 34 operates in conjunction with the other components of the first terminal 4 to perform a process of hierarchical time structuring in accordance with embodiments of the present invention.

In an alternative embodiment, when executed on the respective processors 22, 46 of the first and second terminals 4, 16, the first and second controller applications 34, 56 operate in conjunction with one another and the other appropriate components described above to perform the process in accordance with embodiments of the present invention.

Figure 5 provides a schematic illustration of a transport stream 69 as might be broadcast to a set-top box 4 from a television network 2 (or transmitted from an IP television network 11, 1').

The transport stream comprises one or more interleaved channel streams of one or more respective television channels 1...n carrying the respective program content, and typically one or more separate data streams carrying additional information such as an EPG. This set of one or more data streams may be referred to as the "service information" 84. Each of the television channels 1...n and the data channels are included in a table carried in the multiplexed signal, i.e. in the transport stream (see below). Each of the television channels 1...n and the data streams is also transmitted in a different respective multiplexing slot of the time-multiplexed transport stream. Different sets of channels may also be broadcast in different transport streams (not shown) on different frequencies, hence making use of both time and frequency multiplexing. The EPG need not be included in every transport stream, but could be included in only one or some of the transport streams.

Each television channel, e.g. channel n, comprises an elementary video stream 70 providing the main video content of the channel in question, i.e. the actual main scheduled program, film or

commercial that the user is watching. The television channel also comprises one or more elementary audio streams 72 providing the main audio content of the channel in question, i.e. the speech, sound effects or music associated with the main video content, and may include one or more data streams containing interactive content ("carousels").

In addition, the television channel n comprises embedded metadata 74. For example the metadata 74 may be embedded in accordance with an HbbTV standard. The metadata 74 is embedded in the particular channel n but is nonetheless a distinct part of the channel than the main video stream and main audio stream carrying the main video and audio content.

Each of the elementary streams has an identifier (ID) which is unique across a transport stream. In order to tell which elementary streams belong to which channel, in a typical broadcast scenario the transport stream includes one or more further elementary streams containing further metadata in the form of a table 82 that describes how the other elementary streams are grouped into channels (e.g. to specify that channel 1 consists of the elementary streams with the IDs 101,102, 104 and 105; channel 2 consists of the elementary streams with the IDs 202, 202, 203 and 105, etc.). That is, the table specifies which elementary streams, including their individual associated metadata, belong to each channel. This table is then used at the receiving end to determine what streams to decode and to match embedded metadata 74 to its respective individual channel. In this sense the metadata 74 is embedded in a particular channel n in that it is attached to the channel by the table 82.

As mentioned, the transport stream can also include one or more other elementary streams 84 (the "service information") carrying metadata aimed at the end user such as EPG data describing the programmes on individual channels. Unlike the other streams and their embedded metadata 74, which are each tied to a specific channel, data in the one or more data streams 84 is associated with the transport stream as a whole rather than individual channels.

In the case of IP-delivered channels, a transport stream will only carry one channel so embedded metadata may be embedded in this way. Further, any general human-readable metadata 84 may be carried outside of the transport stream, since there is a two-way connection between the receiver and the head-end, rather than the one-way connection that exists in a traditional TV network.

By whatever means delivered, the metadata 74 comprises at least a portion 78 defining or otherwise relating to interactive content. An interactive application may be run at the receiving end of the broadcast in order to act upon the received metadata. In accordance with embodiments of the present invention, this application is stored on a storage medium 50 of the second terminal 16 and arranged to run on the processor 46 of the second terminal 16 (e.g. as part of the controller application 56 or in conjunction with it as one of the other applications 58). Interactive content comprises content which is supplementary to the main video content 70 and main audio content 72, and which is to be accessed by at least one additional user activation supplied by the user during output of the main video content to the screen 6 (in addition and subsequent to the user activation required to initially select the television channel for output to the screen). For example this could involve pressing a certain coloured button on the remote control while the user is watching a program or commercial, thereby summoning interactive content in the form of text, graphics, supplementary video or even an application relating to some aspect of the program or the advertised product. In some cases the interactive content could involve multiple additional user interactions, e.g. in the case of an interactive application such as an interactive quiz show.

In a preferred embodiment the portion 78 defining the interactive content comprises a link such as a URL (Uniform Resource Locator) or other such network locator, linking to a server from which the interactive content can be retrieved via the Internet 20 or other such IP or packet-based network. Another option is that the metadata portion 78 may comprise a link that references content contained in the carousel carried by the broadcast stream, as opposed to a server.

Alternatively or additionally, the idea of interactive content may refer to content such as a user interface by which the user can interact, e.g. a menu screen or overlay providing the user with options for performing certain user actions to interact with the application. In this case at least elements of the interactive user interface are specified or controlled based on the portion 78 of metadata defining or relating to the interactive content. That is, the metadata 78 may comprise data that is understood by an interactive application running on the second terminal 16. For example the interactive application may be arranged to perform certain on-screen or audible actions when triggered by the metadata (e.g. as part of an interactive quiz or other game). The interactive application itself may have been linked to and downloaded based on other received metadata processed by another application.

In a particularly preferred embodiment, the metadata 74 also comprises another portion in the form of time structure information 80. This portion 80 may define at least the first level time windows L1 in which the respective items of interactive content are valid for access as interactive content. For example during a program a time window may be defined in which a particular product placement appears on screen (e.g. when the user sees their favourite actor wearing a particular brand of clothing). On condition that the user activates the relevant user input at time that is consistent with that time window (e.g. pressing a particular coloured button on the remote when the product is seen on screen) then he or she is provided with web content giving more information on that product or is redirected to a website on which the product can be purchased. A similar idea could be used during explicit commercials, or to provide information on recipes occurring within cookery programs, etc.

Further, the time structure portion 80 may comprise data which at least partially defines the higher level time structure, i.e. defining the one or more higher level time windows L2, L3 or even higher.

Where a time window is defined in the metadata 74, 80, this is preferably defined relative to the timing of the video stream 70 (or possibly audio stream 72) in the particular channel with which the metadata in question is associated. This could be achieved by including in the metadata74, 76 an explicit definition of the time window specified in relation to synchronisation information included in the video elements 70.

The metadata may also comprise yet another portion 76 defining other information for other purposes.

Note that the sizes and order of the various different data elements 70, 72, 74, 76, 78 and 80 in Figure 5 are only schematic and are not necessarily limiting, although it is intended to show that the different channels are preferably interleaved with one another within the transport stream 69 and the elementary streams and metadata 70, 72, 74 are preferably interleaved with one another within a given channel n.

The metadata 74 is preferably extracted from the selected channel, e.g. channel n, at the receiving set-top box 4. This includes extracting the timing information 80.

In accordance with a first embodiment of the present invention, the first controller application 34 running on the first terminal 4 is configured to use the extracted timing information 80 from the extracted metadata 74 to determine the hierarchical time structure, and furthermore to receive user operations of the first and second type, e.g. via single and double presses of a button on an RCU of the first terminal 4. The first controller application 34 is configured to then implement the scheme as described in relation to Figures 6, 7a and 7b, using the screen 6 of the first terminal 4 to output the list, and using user inputs of the first terminal 4 to operate the list and thereby access the selected interactive via the screen 6 of the first terminal 4.

In accordance with a second embodiment of the present invention, the first controller application 34 running on the first terminal 4 is configured to forward the metadata 74 to the

second controller application 56 running on the second terminal 16, via the wireless connection established between the wireless transceiver 14 on the first terminal and wireless transceiver 18 on the second terminal 16 (and the associated drivers and protocols 44, 62 and APIs 38, 60). This would include at least forwarding the timing information 80. In this case the second controller application 56 is configured to receive user operations of the first and second type and to implement the scheme as described in relation to Figures 6, 7a and 7b, using the screen 17 of the second terminal 16 to output the list, and using user inputs of the second terminal 16 to summon and operate the list and thereby access the selected interactive via the screen 17 of the second terminal 16.

In a variant of the second embodiment, the first controller 34 may process the timing metadata 80 at the first terminal 4 so as to generate the hierarchical time structure or list on the first terminal 4, and the first controller 34 may then forward the processed structure or list to the second controller 56 on the second terminal 16 so that only the user interface aspects of the scheme are manifested at the second terminal 56. In yet another variant, information on the structure could be forwarded to the second controller 56 in part processed form for completion of the processing to generate the structure or list to be completed on the second terminal 16.

In either embodiment, the relevant controller 34 or 56 may be configured to store the generated list on a storage medium 24 or 50 of the first or second terminal 4 or 16 respectively. The relevant controller 34 or 56 would then retrieve the list for use once at least the higher level time window for which the list was generated has expired, and/or in embodiments when a further user operation is performed to retrieve and make use of the list.

A third embodiment may combine the first and second embodiments as two different modes of operation. In this case, the first controller 34 may be configured to operate in accordance with the first embodiment (where the list is generated and accessed entirely on the first terminal 4) on condition that it detects that the user operation summoning the list is received via a user input of the first terminal 4, and/or on condition that it detects that the second user terminal

16 is not present on the wireless connection 14, 18. But the first controller 34 will be configured to operate in accordance with the second embodiment (where the list is at least partially accessed using the second terminal 16) on condition that it detects that the user operation summoning the list is received via a user input of the second terminal 16, and/or on condition that it detects that the second user terminal 16 is present on the wireless connection 14, 18. For example either of these conditions triggering the mode in accordance with the second embodiment could be detected at the first controller 34 based on a request signal or instruction from the second controller 56 (depending on which is master).

Note that where it is said that metadata is transmitted or forwarded to the second terminal 16 or such like, this does not exclude the possibility that the metadata may first be reformatted to some extent, e.g. to repackage into a different packet format, or to interpret or process the metatdata and forward on instructions representing the relevant meaning of the metadata to the controller. I.e. metadata could be transmitted in raw form to the second terminal 16 or could be processed to transmit the metadata in modified form.

In a preferred embodiment access to the interactive content comprises the first or second controller application 34 or 56 processing the URL 78 or other such link in order to download the interactive content from the server hosting the content on the Internet 20 or other such packet-switched data network. In the case where the interactive content results from the user being directed to a website, the access to this content may also comprise the first or second controller application 34 or 56 sending information on the uplink to the server on the Internet 20 where the site is hosted, e.g. to supply payment details for online purchases relating to product placements or commercials seen in the main video 70.

When access to the interactive content by the second controller 56 is via a URL or such like, the second terminal 16 may be arranged to access this content via one or more of a number of possible means of connection to the Internet 20 – either directly from the second terminal 16 via the wireless transceiver 18 and wireless router 15, or the cellular connection 48; or via the

connection between the two wireless transceivers 14, 18 and one of the interfaces 3, 5' or 13 on the first terminal 4.

A further possible mode of operation relates to the notifications. The controller application 34 or 56 on the first and/or second user terminal 4 and/or 16 may be configured to allow the user to set a mode or configuration setting specifying whether he or she wants to immediately see the results of the first and/or second user interaction (e.g. single and/or double presses) or instead wants to have them queued up for later. If the setting is set to a first state, the first or second controller application 34 or 56 would be configured to immediately output the interactive content (in the case of the first type of user interaction summoning a single item) or the list (in the case of the second type of user interaction) to the first or second screen 6 or 17 as appropriate to the embodiment in question. On the other hand if the setting is set to a second state, the first or second controller application 34 or 56 would be configured to store the interactive content or store a link to the interactive content (in the case of the first type of user interaction) or store the list of items of interactive content (in the case of the second type of user interaction) for output to a screen later. Separate settings could be provided for the first and second types of user interaction, or these could both be controlled by the same setting.

In one example, storing the list for later could mean that the first or second controller application 34 or 56 would be configured to send a message, such as an email, comprising a link or list of links to the interactive content to a certain address. The message could be arranged to be sent a predetermined period after the last (most recent) addition to the pending list, e.g. one hour. Preferably the predetermined period should approximate the end of a viewing session, e.g. the length of a program. Note also that in this example, the list could therefore even be sent to a third user terminal such as a desktop computer for output on a third screen associated with that third terminal, and the interactive content could be accessed at that terminal also, e.g. by accessing the links in the email or other such message.

In some embodiments, the controller application 56 on the second terminal 16 may also be configured to provide general remote control features, e.g. to change channel or access the EPG. In such embodiments, the controller application 56 on the second terminal 16 is configured to transmit instructions to the first controller 34 on the first terminal 4 via the wireless connection 14,18 and the APIs 38, 60. The first controller application 34, upon receiving an instruction from the second controller application 56, may then in turn issue instructions to the hybrid TV application layer 36, e.g. to control the TV user interface (UI). In response to instructions from the second controller application 56, the first controller application 34 may also issue requests to its operating system 32 requesting access to underlying driver and hardware resources 3, 6, 8, 10, 12, 13, 14, 24, 28, 40, 42, 43 and/or 44. Thus the user is able to change channel or operate an EPG on the screen of the first terminal 4 but controlled from the second terminal 16, e.g. by a touch-user interface on the second terminal's screen 17.

In further embodiments, the second controller application 56 is also configured to be able to make use of the demultiplexer 8 on the first terminal 4 to retrieve the EPG from the data channel, from amongst the multiplexed television channels and data channel, and to receive the EPG over the wireless connection 14,18. The EPG can then be displayed on the screen 17 of the second terminal and operated on the second terminal 16.

Further, the second controller application 56 may be configured to fetch and mimic the user interface of the first terminal 4 on the screen 17 of the second terminal 16.

It will be appreciated that the above embodiments have been described only by way of example. Other variants may become apparent to a person skilled in the art given the disclosure herein. The scope of the present invention is not limited by the described embodiments but only by the appendant claims.

Claims

1. A method comprising:

at a television receiver, receiving a television channel comprising main video content, and receiving metadata relating to a plurality of items of interactive content each associated with the main video content of said channel at different respective times;

outputting at least a portion of the main video content to a screen;

at processing apparatus of a user terminal, determining a hierarchical time structure for the received television channel relative to the main video content, the hierarchical time structure comprising a plurality of nested levels in the form of a lowest level and at least one higher level ordered from lower to higher level, each level comprising a plurality of time windows, each time window of the lowest level corresponding to a different respective one of said items of interactive content, and each time window of each of the one or more higher levels corresponding to a different respective plurality of the time windows of its next lower level in the hierarchical time structure; and

receiving user operations at a user terminal;

wherein a first one of said user operations accesses on screen the item of interactive content associated with a current lowest level time window, being one of said lowest level time windows defined as current relative to the output of the video content based on the first user operation; and

wherein at least a second one of said user operations generates a list of the items of said interactive content corresponding to a plurality of lower level time windows within a current higher level time window, being one of said higher level time windows defined as current relative to the output of the video content based on the second user operation.

2. The method of claim 1, wherein the time structure is defined in said metadata, the metadata is embedded in the received television channel, and the determination of said time

structure comprises reading the time structure from the television channel received at said television receiver.

3. The method of claim 1 or 2, comprising outputting the list to a screen, receiving a user selection of a selected one of the items from said list, and accessing the selected item on screen

4. The method of claim 3, wherein the second user operation causes the list to be stored on a memory medium; and the method comprises outputting the list to a screen following expiry of the current higher level time window, receiving a user selection of a selected one of the items from said list, and accessing the selected item on screen, the list thus enabling deferral of the interactive content.

5. The method of claim 4, comprising detecting a setting determining whether the list is to be stored or displayed immediately in response to the second user interaction, and conditionally storing the list in dependence on said setting.

6. The method of claim 3, 4 or 5, wherein:

said receipt of the television channel and metadata is at the television receiver of a first user terminal, and said output of main video content is to a screen of the first terminal;

the second user operation causes one of (i) the list to be generated at the first terminal and forwarded to a second user terminal via a wireless link, and (ii) information on said time structure to be forwarded to the second terminal via the wireless link and the list to be generated at the second terminal; and

the method comprises outputting the list to a screen of the second terminal, receiving a user selection of a selected one of the items from said list at the second terminal, and accessing the selected item on the screen of the second terminal.

7. The method of claim 6, comprising operating a system comprising the first user terminal and second user terminal in two different modes: a first mode in which the list is output to the

screen of the first terminal and a second mode in which the list is output to the screen of the second terminal by said wireless link.

8. The method of claim 7, wherein the mode depends on whether the second terminal is detected to be present on said wireless link.

9. The method of claim 7 or 8, wherein the mode depends on whether the second user operation is performed at the first terminal or the second terminal.

10. The method of claim 6, 7, 8 or 9 wherein the first terminal is one of: a television set comprising said screen of the first terminal, and set-top box for plugging into said screen of the first terminal.

11. The method of claim 6, 7, 8, 9 or 10, wherein the second terminal is a portable terminal.

12. The method of claim 11, wherein the second terminal is one of a tablet and a laptop computer.

13. The method of any preceding claim, wherein the first user interaction comprises a single press of a remote control unit, and the second user operation comprises a double press of said button.

14. The method of any preceding claim, wherein the metadata comprises a link to a server, and accessing the interactive content comprises retrieving the interactive content from the server via a packet-based network based on the link.

15. The method of claim 5 and 14, comprising sending to an address a message comprising links to the items of interactive content in the stored list.

16. The method of any preceding claim, wherein the television receiver comprises: a receiving interface at which a plurality of concurrent multiplexed television channels are concurrently made available from a television network, each television channel comprising a respective video stream, and a demultiplexer which demultiplexes the selected television channel from amongst said television channels.

17. The method of claim 16, wherein the receiving interface comprises an input from at least one of a satellite dish and a radio-frequency antenna, at which the plurality of television channels are made available on a plurality of different frequency bands, and the demultiplexer comprises a television tuner which tunes to the frequency band of the selected television channel.

18. The method of any preceding claim, wherein the television receiver receives the television channel from a private television network.

19. A computer program product comprising code embodied on a non-transitory computer-readable medium and configured so as when executed on a processor to perform the operations of any of claims 1 to 18.

20. A terminal for use in a system in which a television channel comprising main video content is received at a television receiver along with metadata relating to a plurality of items of interactive content each associated with the main video content of said channel at different respective times, and at least a portion of the main video content is output to a screen; the terminal comprising:

a processing apparatus configured to determine a hierarchical time structure for the received television channel relative to the main video content, the hierarchical time structure comprising a plurality of nested levels in the form of a lowest level and at least one higher level ordered from lower to higher level, each level comprising a plurality of time windows, each time window of the lowest level corresponding to a different respective one of said items of

interactive content, and each time window of each of the one or more higher levels corresponding to a different respective plurality of the time windows of its next lower level in the hierarchical time structure; and

a user input for receiving user operations;

wherein a first one of said user operations accesses on screen the item of interactive content associated with a current lowest level time window, being one of said lowest level time windows defined as current relative to the output of the video content based on the first user operation; and

wherein at least a second one of said user operations generates a list of the items of said interactive content corresponding a plurality of lower level time windows within a current higher level time window, being one of said higher level time windows defined as current relative to the output of the video content based on the second user operation.

21. A terminal in accordance with claim 20, further configured in accordance with any of claims 2 to 18.

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Claims searched: 1 to 21 **Date of search:** 12 October 2011

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US 2004/0125124 A1 (KIM et al) see paragraph [0103]
A	-	EP 1496701 A1 (MITSUBISHI ELECTRIC)

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H04N

The following online and other databases have been used in the preparation of this search report

EPODOC; WPI; TXTE

International Classification:

Subclass	Subgroup	Valid From
H04N	0007/173	01/01/2011
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